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IS THE WESTERN AUSTRALIAN WHEAT-BELT A NATURAL REGION?

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A natural region must be homogeneous enough to show some unity. At the same time, it must be different enough from the nearby regions to show some individuality.

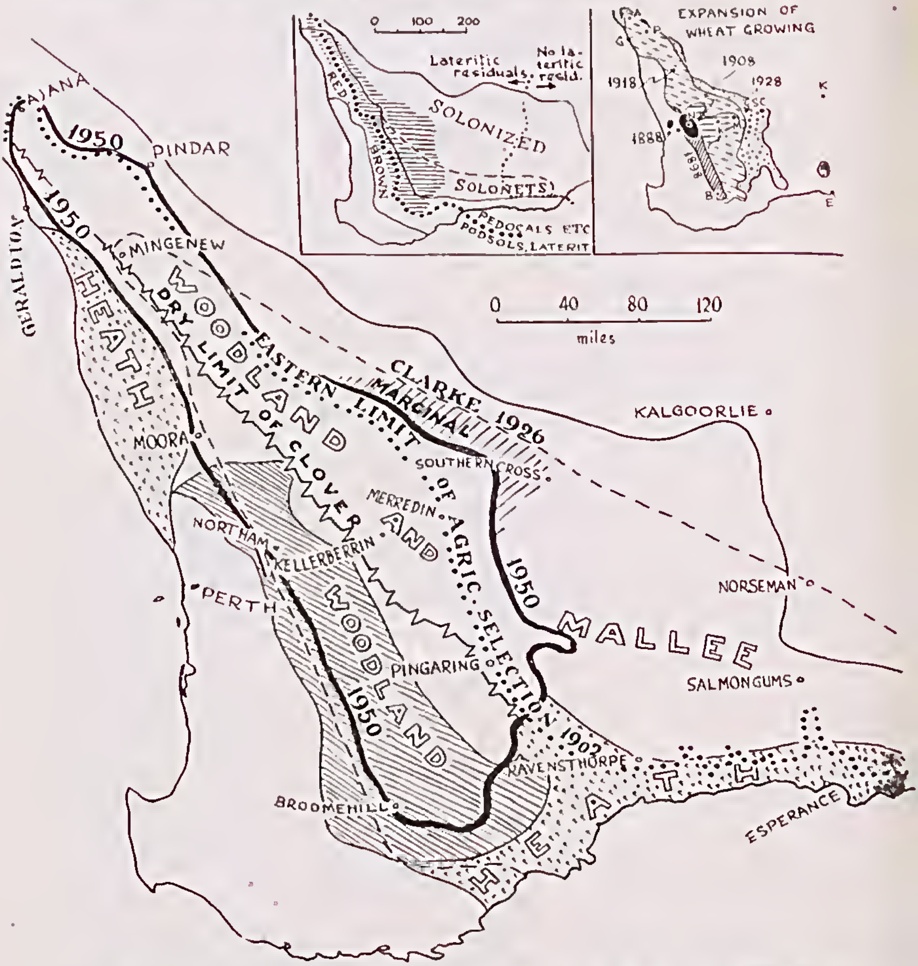
In 1906 the statistical year book issued by the government of Western Australia included a map showing the agricultural land open for selection as at the end of 1902. On this map the 12-inch rainfall line was taken as the eastern boundary of this agricultural land. It was obviously meant to show the limit of the Western Australian area where wheat was expected to succeed as a crop; its position is shown by a dotted line in the map.

The suggestion that the (potential) wheat-belt might be a natural region came from Clarke (1926) who divided Western Australia into 15 regions. Geological factors accounted for some eight regions and climatic factors for the remaining seven regions.

The "Older Pre-Cambrian Central Shield" was divided into four regions: Northern, mainly summer rain, predominant Mulga vegetation; Central, winter rain, predominant Eucalypt vegetation; South-Eastern, winter rain, 10 in.-25 in., Salmon, York and Morrell association; South-Western, winter rain, 25 in. or more, Jarrah association.

The third one of these regions was given the name of "Wheat Belt." Its limits as outlined in Clarke's map are shown by a dashed line in our map. A more detailed plotting of the 10-inch and 20-inch isohyets, based on more adequate data now available, would alter the position of these limits to some extent but not considerably. Some adjustment would also be necessary in the light of modern studies of rainfall effectiveness, since it is obvious that plants growing near the northern limit of this area, where temperatures are 5 to 8° F. higher than near the southern limit, will need more water for their transpiration. It is estimated that the excess water-need of the northern areas varies from about 9 mm. (36 points) in July to about 13 mm. (52 points) in February, with a total of 62 mm. (just over 250 points) for the May-October period. The equivalent of the 10-inch limit in the south-east would be a 13-inch limit in the north-east.

From the biological point of view it seems questionable whether the wheat plant could ever be taken as a standard or a criterion for any "natural" concept. Thanks to the work of plant breeders and geneticists, the wheat plant has undergone a series of controlled and directed evolutionary processes at a rate far faster than any rate of natural selection. The climatic limits of wheat-growing are thereby affected, e.g., rust-resistant varieties can grow in warmer and more humid areas, drought-resistant varieties can expand into drier areas. However, Clarke was rather optimistic when he fixed the eastern limit of the wheat-belt at the 10 in. isohyet—like the "Goyder line" in South Australia this limit was far from definitive.



The Western Australian Wheat-belt. Eastern limit of agricultural selection 1902 (dotted), limit of "Wheat-belt natural region" of Clarke, 1926 (dashed), limit of wheat-growing in 1950 (thick line). Marginal wheat area shaded, dry limit of subterranean clover shown by jagged line. Vegetation regions shown in white capital letters, heath stippled and woodland shaded. Left inset: soil regions and boundaries. Right inset: isochrones of wheat-growing (the western 1888 area was no longer under wheat by the beginning of the century).

The expansion of the actual wheat-belt, as distinct from the reputed potential wheat-belt, was rapid. From the statistics available, Roberts (in Clarke, 1936) obtained a series of maps which show the successive stages of this expansion at 10-year intervals from 1888 to 1928. From these maps was prepared the isochrone map shown in the right inset.

The disastrous fall in world prices caused by the economic depression of the early 'thirties made wheat-growing uneconomic in the districts with a barely adequate and relatively variable rainfall. Many farmers in the Mount Marshall, Mukinbudin, Westonia districts and as far east as Southern Cross were forced to surrender their land to the Crown, and a new subdivision of the area into much larger farm units was carried out. Sheep for wool took the place of wheat. The map shows this marginal area shaded. Some wheat is grown in it still, but as a sideline and not as a staple crop.

It was by then clear that the geographical boundaries of wheat-growing were controlled by economic factors as well. The reversion to the Crown of "marginal" farm-land resulted in a contraction of the wheat-belt in that area. Even though the building of new roads in the south-eastern lakes area allowed some moderate expansion in that direction (e.g. Lake Varley, N.W. of Ravensthorpe), the actual wheat-belt is even now far from reaching the size outlined in the early maps. Its present boundary is shown by the thick line on the map, with the symbol 1950. The high price of wool in the 'fifties caused a reduction in the relative importance of wheat to wool in the agricultural economics of the wheat-belt. Especially on the western-wetter-margin, pasture crops are increasingly preferred to wheat. Subterranean clover is now quite an important crop in the 15-25 in. belt and its eastern limit is shown by the saw-tooth line on the map. The new areas now open for settlement are devoted to sheep-farming, even within the old "wheat-belt" limits.

Climatically the wheat-belt is not homogeneous, except in the minimum requirements for the growth of the wheat plant. The average annual rainfall varies from about 12 inches in the east to over 17 in the west. The average number of wet days in a year varies from 60 in the north to over 100 in the south. This exceptional range is explained by the greater concentration of the rainfall in the wheat-growing season (winter) in the north. From May to October Geraldton receives 1576 points out of an annual total of 1858, or 85 per cent. In the same period Broomehill receives 1320 points out of an annual total of 1802, or 73 per cent.

This different distribution of the rainfall in time has a very important effect on the soils of the southern section. Taking as an example Ravensthorpe, one finds that from May to October the total average rainfall is 983 points falling in 69 wet days, at a rate of 14 points per day. At Broomehill and at Kellerberrin the average for the same period is 16 points per day, at Meckering 18.5, at Mullewa 21, at Geraldton 24. Cyclic salt brought by rain-water (Teakle, 1937) is likely to be carried away in solution where the rainfall exceeds 15 points in a wet day. Where the fall is less than 15 points, run-off is extremely unlikely, and leaching is hardly noticeable. Rain-water sooner or later evaporates and cyclic salt remains within the soil (Prescott, 1931). This is considered the main cause of the peculiarities of the soils in the area which was originally thought of as potential wheat country but could not actually be used.

As a result of extensive surveys Teakle and co-workers contributed in a very considerable way to our understanding of soil conditions in the area studied here. The first general picture of soil geography in the wheat-belt is due to Prescott (1931) but a much more detailed regional analysis was written by Teakle (1938). As the left inset map shows, the wheat-belt (shaded) lies for about one-third in the belt of red-brown earths (with a redder B1 horizon with clay and some calcium carbonate). About two-thirds of the wheat-belt is in the much larger belt of grey and solonized soils (soils with much calcium carbonate and a horizon of illuvial clay). It was actually thanks to the findings of Teakle (1939) that the projected extension of the wheat-belt onto unsuitable soils (the "3500-farms scheme") was not carried out, and disastrous results were avoided.

In a new map by Prescott (1944) the vast area of solonized soils was subdivided into a south-western belt of true alkali (solonetz, mallee) soils, in which the clay shows a distinctly domed and columnar structure, and a larger remaining area of more variable and partly solonized soils. This subdivision was already implicit in the description given by Teakle (1938) of the main soils of each region. The wheat-belt (shaded in the left inset map) thus occupies part of three distinct soil zones.

A complete reappraisal of the characteristics of the soils of the agricultural parts of Western Australia (Smith, 1952) produced a much more complex classification, in which zonal factors are given a subordinate place. The boundary between non lime-accumulating soils (podsols and laterites) on the one hand, and lime-accumulating soils (pedocals and lateritic sands) on the other hand, bisects the belt of red-brown earths and marks the approximate western limit of the wheat-belt at the present time, except between Moora and Broomehill where wheat is grown on soils west of this zonal soil boundary. It should be pointed out, however, that Smith describes the soils of the areas concerned (his Avon and Jingalup combinations) as weakly acid to neutral, so that in respect of acidity they still come within the definition of Teakle's red-brown earths, which Smith does not recognise as forming a distinct zone. The left inset map shows quite clearly that the present wheat-belt (shaded) lies almost entirely within the zone of pedocals and lateritic sands (solonized soils, solonets, etc.), but occupies less than one-third of that zone.

The wheat-belt is now an almost entirely artificial landscape, with a few isolated trees from the original vegetation, and wide expanses of bare reddish soil alternating wth the tender green of crops, mostly wheat and oats, or, on the western side, the richer green of clover. The western, or better the south-western, part of the wheat-belt replaces the woodland shown shaded on the map.

This woodland consisted of trees such as jam *(Acacia acuminata)* and York gum *(Eucalyptus foecunda* var. *loxophleba)* and near the south-western edge wandoo *(E. redunca* var. *elata)*, with shrubs and grasses in the undergrowth. The main part of the wheat-belt replaces the natural sclerophyllous woodland of salmon gum *(E. salmonophloia)*, gimlet *(E. salubris)*, and on the heavier soils morrell *(E. longicornis)*, with patches of mallee (mostly *E. oleosa)* becoming more frequent towards the south-east where they are typical of the solonets soils. Grasses are less common and bare ground more conspicuous than in the woodland farther west. Although the vegetation is characteristically linked with soil types and therefore very patchy, the difference between the woodland proper, with its proportion of savanna-like grassy undergrowth and denser vegetation generally, and the sclerophyllous woodland which shows so much bare ground, stands out clearly and divides the wheat-belt into two distinct parts. For more details see Gardner, 1942.

The writer has previously studied the climates of Western Australia according to different methods of classification, and in each case the arid-semi-arid boundary runs close to Kalgoorlie (in agreement with the corresponding vegetation boundary) while the wheat-belt ends some 120 miles farther west. Where a sub-humid climate is recognised, as for instance in Thornthwaite's 1931 method, the wheat-belt's western boundary practically bisects the belt of sub-humid climate (Gentilli, 1948).

Thus climatological, pedological and botanical evidence concurs in denying the wheat-belt the status of "natural region."

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THE EDGE-GROUND AXES OF SOUTH-WESTERN AUSTRALIA

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"And no one has a right to say that no water-babies exist, till they have seen no water-babies existing; which is quite a different thing, mind, from not seeing water-babies . . . ."
—Charles Kingsley, "The Water-babies."

INTRODUCTION

The edge-ground axe, an artifact of considerable importance in Australian ethnological speculation, is commonly believed not to occur in South-Western Australia (see Davidson and McCarthy, 1957; McCarthy, 1958). However, Noone (1943) has described three artifacts from this region which he considers are possibly edge-ground axeheads indigenous to South-Western Australia.

McCarthy (1939) has shown that trade routes into South-Western Australia existed and there can be little doubt that occasional, rare, edge-ground axes would have entered the South-West through these channels (Bates, 1938; Glauert in McCarthy, 1939), but the artifacts described by Noone do not closely correspond with the types of edge-ground axes known from outside the South-West. It is thus unlikely that they are trade articles. In their recent review of the subject, Davidson and McCarthy (1957) have, however, been unable to accept these implements as axeheads at all.

In view of this disagreement and in view of the theoretical implications of the distribution of edge-ground artifacts, a review of the situation is presented with particular reference to these controversial specimens, and others like them, which are now in the Western Australian Museum.

It is concluded that axeheads did occur in South-Western Australia, both by introduction and by local manufacture.

MATERIAL

The following twelve edge-ground implements, all from localities in South-Western Australia, are in the collection of the Western Australian Museum.